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*March 06, 2006*

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FILING DATE.

APPLICATION NUMBER: 60/353,530

FILING DATE: *February 01, 2002*

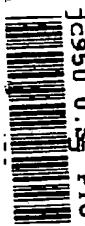
RELATED PCT APPLICATION NUMBER: PCT/US03/03323

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY  
APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS  
CONVENTION, IS US60/353,530



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PTO/SB/16 (8-00)

Approved for use through 10/31/2002. OMB 0651-0032

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**PROVISIONAL APPLICATION FOR PATENT COVER SHEET**

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

**INVENTOR(S)**

Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
Cheng C. Barry	Ko Levine	713 Skynob Dr., Ann Arbor, Michigan 48105 22 Bear Brook Lane, Linvingston, New Jersey 07039

Additional inventors are being named on the \_\_\_\_\_ separately numbered sheets attached hereto

1C657 U.S. PTO  
60/353530  
02/01/02**TITLE OF THE INVENTION (280 characters max)**

Mini-Mesa Avalanche Photodiodes

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<input checked="" type="checkbox"/> Firm or Individual Name	Steven L. Oberholtzer			
Address	Brinks Hofer Gilson & Lione			
Address	P.O. Box 10395			
City	Chicago	State	IL	ZIP
Country	USA	Telephone	(734) 302-6000	Fax

**ENCLOSED APPLICATION PARTS (check all that apply)**

<input checked="" type="checkbox"/> Specification	Number of Pages	2	<input type="checkbox"/> CD(s), Number	
<input checked="" type="checkbox"/> Drawing(s)	Number of Sheets	3	<input type="checkbox"/> Other (specify)	
<input type="checkbox"/> Application Data Sheet. See 37 CFR 1.76				

**METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT (check one)**

<input checked="" type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27.	FILING FEE AMOUNT (\$)
<input type="checkbox"/> A check or money order is enclosed to cover the filing fees	
<input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: 23-1925	
<input type="checkbox"/> Payment by credit card. Form PTO-2038 is attached.	

\$80.00

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

 No. Yes, the name of the U.S. Government agency and the Government contract number are: \_\_\_\_\_

Respectfully submitted,

SIGNATURE

TYPED or PRINTED NAME      Steven L. Oberholtzer  
TELEPHONE      (734) 302-6000

Date      2/1/02

REGISTRATION NO.  
(if appropriate)  
Docket Number:

30,670

10555-029

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P18SMALL/REV05

**CERTIFICATE OF MAILING BY "EXPRESS MAIL" (37 CFR 1.10)**

Applicant(s): Cheng et al.

Docket No.

10555-029

Serial No.

Filing Date

Examiner

Group Art Unit

Invention: Mini-Mesa Avalanche Photodiodes

I hereby certify that this Provisional Application, Transmittal Letter, and Three Sheets of Drawings  
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## MINI-MESA AVALANCHE PHOTODIODES

In an embodiment of the present invention, a way of achieving a localized p-contact region without using a p-diffusion is to etch a "mini-mesa". That is, the full structure is grown initially including the p+ contact, and then it is etched down to the low doped InAlAs contact layer. This defines a small localized p- contact region which controls the relevant capacitance area, thus resulting in a low capacitance, and a high speed APD. We have performed initial experiments with this structure and as predicted it had low capacitance and a high speed response comparable to the regular standard full mesa APD (see Figure 1). The advantage of this structure is that it is completely epitaxially grown initially and does not require any p diffusion. It should have better passivation characteristics than the full mesa since the electric field at the edges of the low bandgap InGaAs is substantially reduced from that in the standard full mesa geometry. The structure can then be passivated with BCB as indicated below.

In a further embodiment of the present invention, a particularly advantageous approach to passivating this structure is to use wet oxidation of the AlInAs layers. The top p AlInAs layer can be oxidized down to the InGaAs or grading layer. At the same time the sides of the outer mesa can be oxidized to passivate it. It may be advantageous to oxidize the AlInAs so that there is a gradual interface between the unoxidized and oxidized AlInAs. This will reduce the field at this interface leading to better passivation. In addition, it may be advantageous to combine this approach with proton or oxygen

implantation to additionally control the p+ charge layer and reduce the field at the edge of the outer mesa to further improve passivation.

*Figure 1*

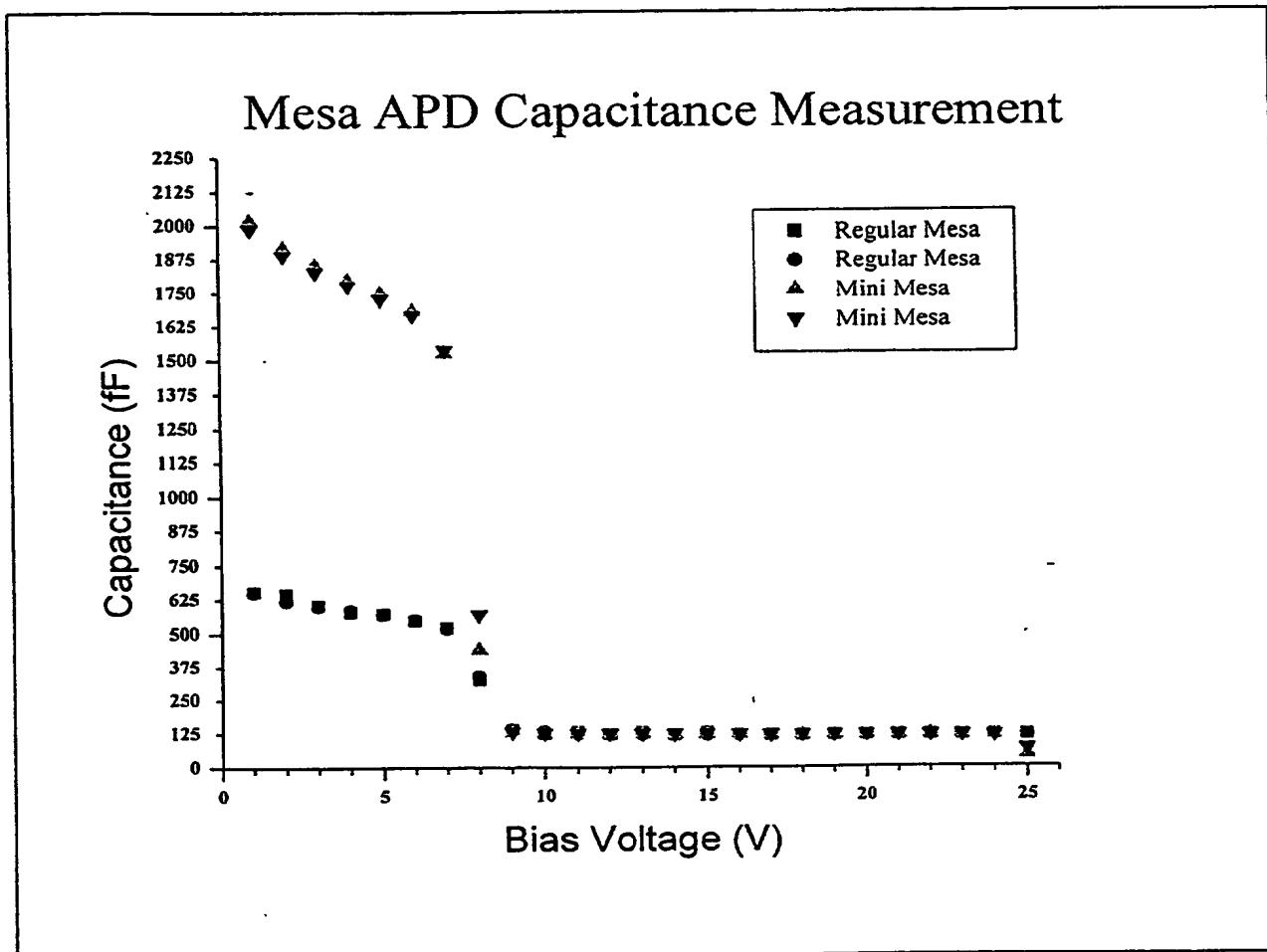


Figure 2

## Mini Mesa APD With oxidized InAlAs

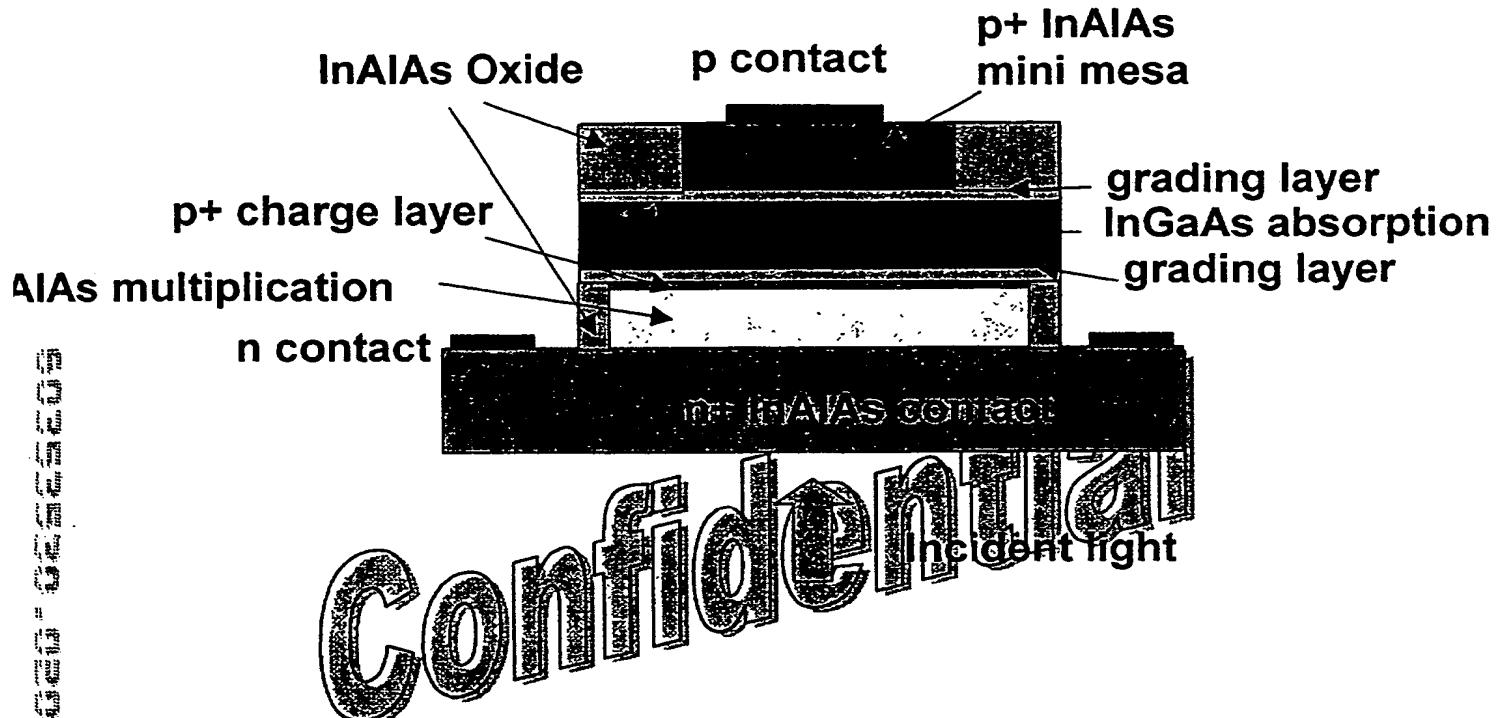


Figure 3

## Mini Mesa APD With BCB Passivation

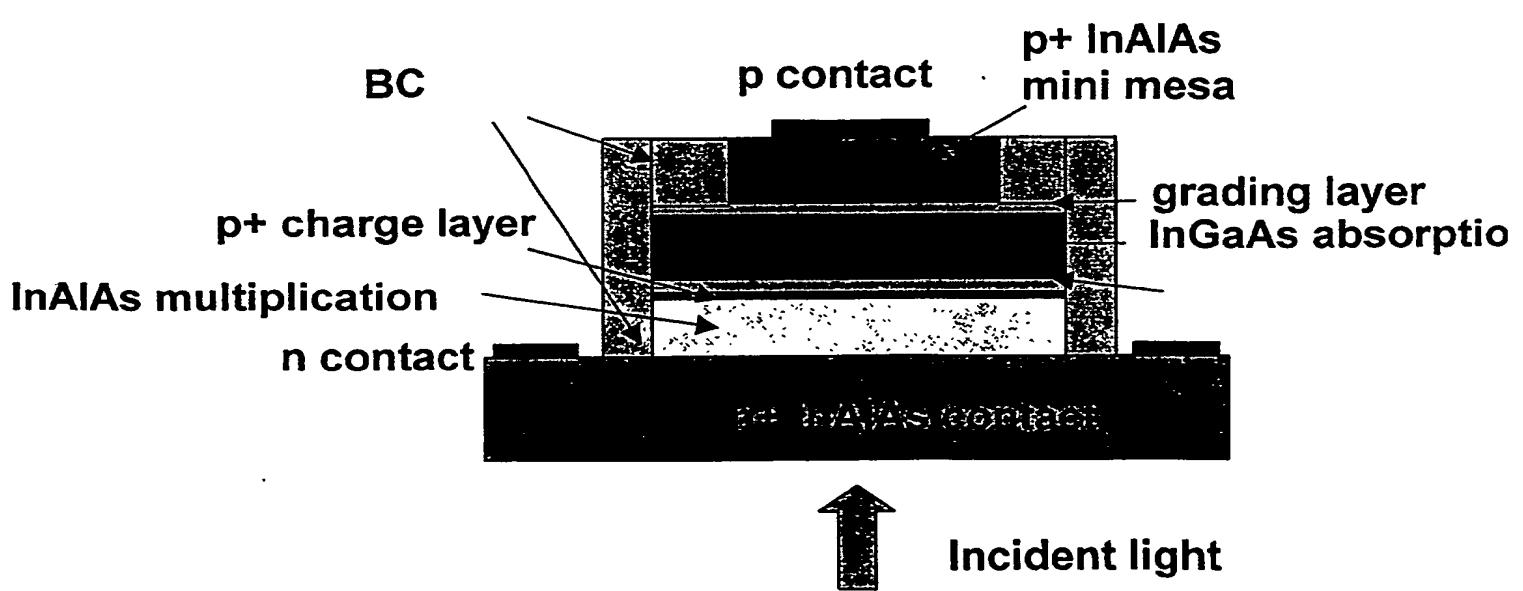
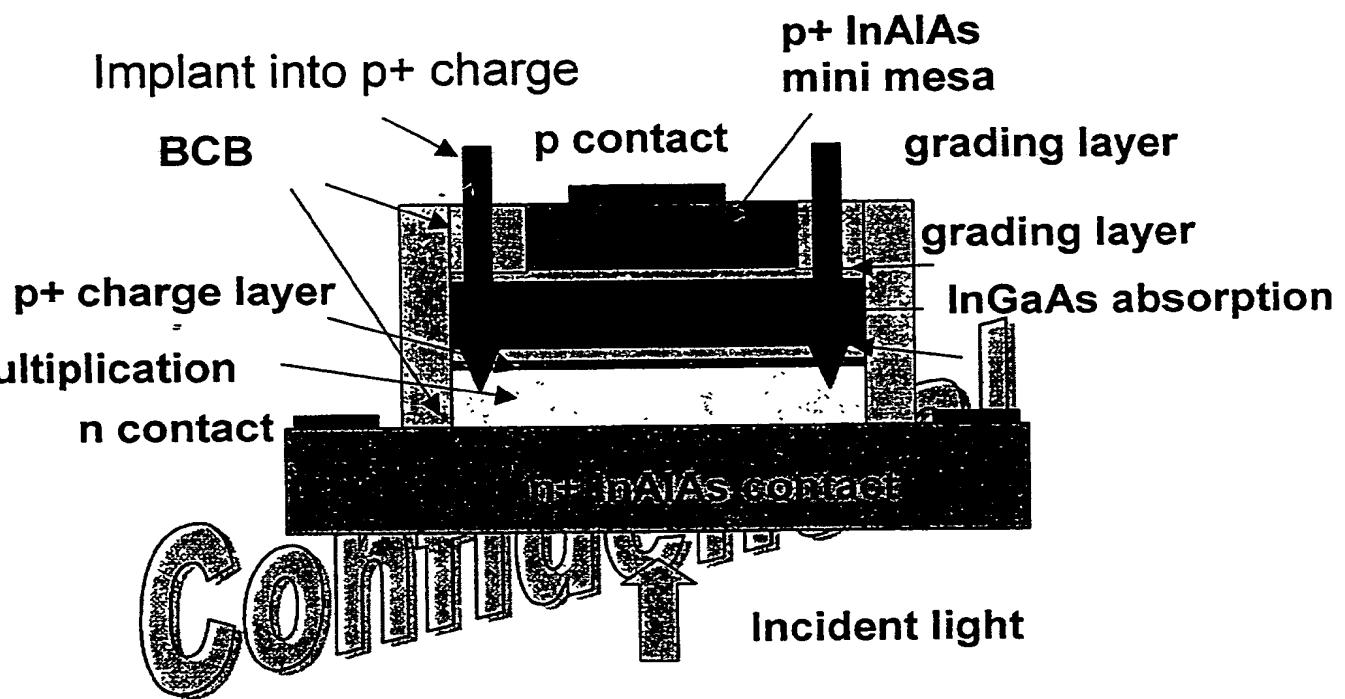


Figure 4

**Mini Mesa APD**  
**With Implant into p+ charge layer**  
**Combined with Either BCB or Oxide Passivation**  
**(BCB shown)**



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